VIP methods for Sports Video - an Analysis

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Abstract:

Video Annotation has become challenging process in the field of Sports Video. An every event with respect to the game requires the precise gloss. This has been done with different Video Image Processing(VIP) Techniques using MATLAB tool. This paper elaborates the all efficient video processing methods applied on the different sports videos and these analyzed results will be tested for Kabaddi Game for image mosaicking in the current case study.

Key words: Object detection, tracking, Kabaddi game, image mosaicking, SVM and optical flow method

INTRODUCTION:

Video processing technology has revolutionized the world of multimedia with products such as Digital Versatile Disk (DVD), the Digital Satellite System (DSS), high definition television (HDTV), digital still and video cameras. The different areas of video processing includes (i) Video Compression (ii) Video Indexing (iii) Video Segmentation (iv) Video tracking etc.

VIDEO SEGMENTATION:

Sports video annotation(SVA) is a well established problem area in machine vision, for which manifestly successful techniques are available. Most of the SVA is done on Tennis, Badminton, soccer game, basket ball and cricket games. In which most efficient and dynamic approaches are listed in this paper along with their detailed performance analysis and results. Later the efficient one will be applied on the kabaddi video annotation process as new SVA software using MATLAB tool.

1. Nicola Greggio [7] and Aseema Mohanty, Sanjivani Shantaiya [11] Proposed an algorithm for real-time video segmentation based on **Gaussian mixture models (GMMs)**, and foreground/background segmentation. Best describes the first video frames, and then it uses these results to describe the further frames. Then foreground/background segmentation procedure is applied. Here, a recursive filter is used to train a mixture background model together with an K-means approximation. But the method fails in multiple object detection.
2. Based on Support Vector Machine and analysis of Optical flow, Gang Liu [8], Guangyu Zhu[13][16] presents a new method for recognizing player motions in broadcast sports video. The video often has problems like bad-quality image, non-static video cameras and low-resolution image of player. To address them, from the perspective of moment analysis and according to the spatial distribution feature of optical flow field of tracked members, the **grid classification** method, a kind of local analysis idea is used to extract descriptive characteristics of moment recognition. With different idea from the tradition flow analysis, the method regards optical flow vectors in the traced areas as a kind of spatial distribution information in the mode of mobility, improving robustness of **optical flow** features. With **SVM** as model classifier and the application of time-sequential voting-strategy, the type of player action is identified. This technique fetches motional descriptive feature achieves better recognition effects and it is applied on **Tennis**, **Badminton** games which achieves the good accuracy rate of recognition at separately 90.7% and 87.6%.

Fig 1: Object detection and tracking sample in Tennis and Badminton

To get the information of outline of the sports track Karumen-Loeve (KV) transform was applied. This is done after reduction background to map the information of outline into an Eigen-space. Then the eigen values are arranged in a descending order, with the Eigenvector of the first m biggest value to form apparent descriptors of action and gestures. Finally nearest neighbor classifier was used to recognize action sequence by according those description.

3. Z.Zivkovic [9] Proposed Hidden Markov Models (HMMs) for human action recognition in the case of events in tennis game . To this goal robust player segmentation algorithm is developed for real video data. Further, introduce a number of novel features to be extracted for particular application. Different feature combinations are investigated in order to find the optimal one. Finally, recognition results for different classes of tennis strokes. HMM have great attention in the field of human gesture and action recognition along with pattern and signal processing.
First step approach is to segment the player from the background, which is supported by a robust player segmentation algorithm that is able to work even with low quality VHS video data. The algorithm is independent of type and colour of tennis court and allows to run large experiments with videos from different tennis tournaments without changing the parameters of the algorithm. In the next step, extract a number of different features from the player binary representation to reach the goals. Then, HMMs are trained using different feature combinations in order to find the optimal one for this particular application. In this domain, general methods, like Fourier Descriptors (FD) or construction of linear subspaces using principal component analysis (PCA) are applied. Different feature combinations for tennis literature are studied. HMM method achieves 85% of accuracy. Only 15% found false recognition in the case of similar stroke videos.

4. David Windridge [10] proposed **Markov Logic Network[MLN]** construction to build an adaptive system for sports video segmentation. The method is tested with tennis footage via computer-vision based approaches including HOG3D based player-action classification, **Hough-transform-based** court detection, and graph-theoretic ball-tracking. Shot boundaries are detected via a breakdown in color histogram intersection between adjacent frames. Shots are then classified using histogram mode **Tennis** court lines are determined via Hough transformation, while player detection is carried out by background subtraction, incorporating geometric spatio-temporal consistency-checking with prior-based masking. Player tracking (as distinct from detection) is carried out via a particle filter, with player actions classified via a nearest neighbor approach using a bag of HOG3D features. For ball tracking, background subtraction is employed to generate initial ball candidates. **SVM** classification is then used to eliminate all but the strongest ball candidates. Ball tracks themselves are established in two stages. First, "tracklets" are built from sets of extracted strong object candidates in the form of second-order (roughly parabolic) trajectories. A **graph-theoretic data-association** technique is then used to link the tracklets into complete ball tracks. Game play events are indicated by significantly above-threshold ball trajectory changes, which are then correlated with other event label indicators such as player action-class in order to obtain an event characterization.
The **MLN**-based method, furthermore, has the advantage of noise-resilience, exhibiting a linear degradation of performance. The MLN method achieves the accuracy level upto 68.18% with the 0% of instantiation .

5. Claudio L. R. Vieira [14] proposed a novel method of automatic rally detection on broadcast tennis videos. This method can be useful to predict and estimate the main physical demands in tennis matches. The method developed in Matlab® (Mathworks, MA, USA) was based on **histogram extraction, percentile statistical filtering, and keyframe histogram spatiogram similarity**. Maximal detection ratio was reached in hard-core playing surface (91%) followed by grass (82%) and clay (71%). The average of automatic tennis rallies detection was 81%. The reasons of rally detection errors are related to the camera motion, court illumination changes, smooth frame transitions, and the false high similarity between a non-rally frame and the keyframe histograms. The rally duration obtained with this method was valid when compared with manual annotation. In conclusion, the proposed method has a good performance, and estimation of its rally duration was comparable with the manual detection method (ground true) for broadcast tennis videos.

Seema Rajput, S. D. Oza [18] proposed a new method for detecting and tracking multiple moving objects based on **Discrete wavelet transform (DWT)** and identifying the moving objects by their color and spatial information.

DWT can divide a frame into four different frequency bands without loss of the spatial information. Localization in both frequency and time/spatial domains is the greatest advantage of DWT over Fourier transform based methods. The algorithm uses Background Subtraction and Boxed Based tracking for aforementioned goals. The proposed model has proved to be robust in different types of static background scenes. The Experimental results prove the feasibility of the proposed methods. DWT based on sub-band coding is found to yield a fast computation of Wavelet Transform [4]. Wavelet transform provides a special basis that a signal can express easily and efficiently [1]. The two dimensional (2-D) DWT has a gained popularity in the field of image and video coding since it allows good complexity –performance tradeoffs. Two dimensional DWT can be used to decompose an image into four sub-images. The four sub images that the wavelet transform preserves not only the frequency features but also spatial features. Filters are applied in one dimension first, vertically or horizontally and then in other dimension. It follows Background subtraction, Normalization and Image restoration process. The method is applied on AVI video with 30 fps.

7. Resmi H.B [22] proposed **Symmetric Mask based on Discrete Wavelet Transform (SMDWT)** has been used in order to compensate for illumination changes and low memory requirement. Symmetric Mask Discrete Wavelet Transform is a low complexity DWT where each filter is derived from the 2- D DWT of 5/3 integer lifting-based coefficients. For fast object tracking variance method is adopted where maximum nonzero pixel value is considered. The experimental results show that the proposed method yields better result on the basis of computational time, memory requirement, speed of operation and environmental changes than the conventional DWT [18] based approach. Using SMDWT accurate detection can be achieved; here the memory requirement is also less. The use of variance method for tracking increases the computational speed to a great extent. The comparative results show that proposed method is much better than the conventional approach in detection and tracking time. On account of these advantages, the proposed method is very suitable for real time applications such as video surveillance, traffic monitoring system etc. Both algorithms are applied on many sample videos, the experimental results shown in computational time variation in seconds up-to 5.2(SMDWT), 6.91[DWT].

8. Wei-Lwun Lu [2] proposed DPM method for Player detection and tracking in Basketball sports video. First shot segmentation preprocessing is done using **Hidden Markov Model (HMM)**. The emission probability is modelled by a Gaussian Mixture Model (GMM) where features are RGB color histograms, and the transition probability is formulated to encourage a smooth change of shots. We then run the Viterbi algorithm to find the optimal configuration of the graphical model in order to segment the video into different shots. **Deformable Part Model (DPM)** to automatically locate sport players in **basketball** video frames. it may fail to detect players when they are partially occluded by other players. To assign a game time-stamp to every video frame, we run an **optical character recognition (OCR)** system to recognize the clock numbers showing on the information bar overlaid on the videos. The OCR system has nearly perfect accuracy because the clock region has a fixed location, and the background of the clock is homogeneous. **logistic regression classifier** for image classification based on the RGB color models. It is possible to add color features to the DPM detector and train a player detector for a specific team. For state estimation of players **Linear Gaussian transition** model and Linear Gaussian observation model are used**. Kalman Filter model** is applied to fill the gaps. The semi-supervised learning algorithm is a variant of **Expectation-Maximization (EM)**. The identification system achieves an average accuracy of 85% for Lakers players and 89% for Celtics players.

PROPOSED CASE STUDY

By evaluating all the above explained methods and those outcomes The SVM based segmentation and optical flow methods are more efficient for the sports video analysis. Consequently, we have applied the morphological operations on the Kabaddi game to segment players in half of the kabaddi court. Which has shown the good result[29]. Then image mosaicking (backward observation of players towards the goal) has to be done object tracking by testing efficient techniques on the self developed videos.

Fig 2. An blue print of Kabaddi Court

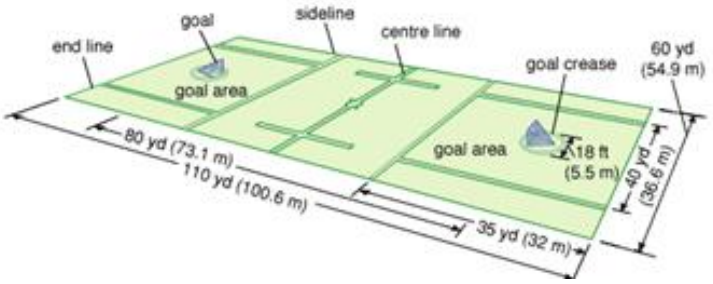
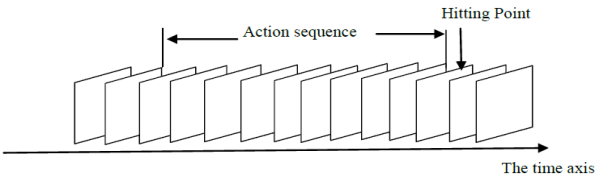


Fig 3: Event handling through frame by frame analysis



Then event recognition will be done by tracking the teaser and the chaser. To get this every moment of the teaser should be kept in observation so that the goal point and the number of outs in the opposite team(chasers) will be detected.

CONCLUSION

Since the VIP(video image processing) have taken the vital role in all the broadcast sports video analysis, many techniques and the softwares have introduced with respect to the game issues. In this case study issues in the kabaddi games have discussed. For event analysis the SVM using optical flow method is an efficient technique as compared with the other methods. For the accuracy fixed cameras will be used in middle line and the end line of half of the kabaddi court.

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Num	Author Name	Technique Introduced	Accuracy Level
1	Gang Liu [8], Guangyu Zhu[13] Chetan G Kagalagomba[16]	Support Vector Machine (SVM) and Optical flow, Karumen0Loeve (KV) Grid classification Method	Tennis, Badminton 90.7% and 87.6%
2	Z.Zivkovik[9]	Hidden Markov Model(HMM)	85%
3	David Windridge [10]	Markov Logic Network(MLN), graph theoretic data-association	61.18%
4	Claudio L.R. Vieira[14]	Histogram Extraction, percentile statistical filtering, and keyframe histogram spatiogram similarity	91%
5	Wei-Lwum Lu[2]	Deformable Part Model(DPM)	Basket Ball 89%
6	Seema Rajput, S.D. Oza[18]	Descrete Wavelet Transform(DWT)	4.49 CT%
7	Resmi H.B[22]	Simmetric Mask based on Descrete wavelet Transform (SMDWT)	2.17CT%
8	Khurram Soomro[23]	Deformable Part Model(DPM)[2] Support Vectore Machine[1] On 10 UCF sports videos	97.5%

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